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of about a dozen words of the same category as the terms compared. Thus: "Apples, pears, cherries, nuts, peaches, grapes, strawberries, dates, figs, raisins,—which do you like better, grapes or cherries? Cherries." *M*, 694 σ (v. 130 σ); *R*, 659 σ (v. 160 σ),—a shortening of 212 σ and 460 σ as compared with (5). (7) A combination of (3) and (6); instead of first asking for a drama of Goethe's, and then asking which is the finest, this, that or the other, we ask at once, "Which is the finest drama of Goethe?" *M*, 962 σ (v. 180 σ); *R*, 1137 σ (v. 160 σ). (8) This is a comparison between a given term and a term derived by process (7); thus, "Which is the more westerly, Berlin or the most important German river? Rhine." *M*, 1844 σ (v. 370 σ); *R*, 1866 σ (v. 340 σ). (9) Bears the same relation to (8) that (7) does to (4); the type of query being, "Which lies more westerly, Berlin or the river on which Cologne is situated?" *M*, 1291 σ (v. 180 σ); *R*, 1337 σ (v. 230) or 553 σ and 529 σ less than (8) while (7) is only 154 σ , 248 σ less than (4). (10) is (9) preceded by a series of terms of the same category as those to be compared. *M*, 1153 σ (v. 170); *R*, 1145 σ (v. 210), or 138 σ and 192 σ less than (9). The results are based upon 890 experiments in all.

After again fiercely combatting Wundt's apperception theory in its relations to these results, Dr. Münsterberg attempts their interpretation, in which the four following relations may be selected as most important: (a) that the time of a free association is shorter than of a limited association, (2) shorter than (3); (b) the question-answer association is shorter than the limited, (4) than (3); (c) that the reading of the series of words before the question shortens the time, (6) is shorter than (5) and (10) than (9); (d) the combination of any two or three factors in the same process takes less time than the sum of the times needed for each of the factors separately; compare (9) with (3) and (5). Relation (a) is not new and is readily explained by considering that in one case *any* association aroused by the call-word will answer, while in the other case several associations may arise that must be rejected. Fact (b) seems to indicate that we do not call up first the general notion and then the particular, but seem to have a direct and usually prominent association with the particular, the irrelevant general association not being "apperceived." The third fact indicates the mechanism of preparation, certain general lines of association being already ruled out by the formation of the category-series, and thus less of the mental labor comes into the measured time. The fourth circumstance shows again the overlapping of mental processes; the mind is not a point through which each process must pass in turn, but is a plane in which the most complex interactions have play. For the acceptance and further development of the interesting results of these studies we must look to the future.

J. J.

L'Énergie et la Vitesse des Mouvements Volontaires. CH. FÉRÉ. *Revue Philosophique.* Juillet, 1889.

In this paper Dr. Féré gathers up the results of a number of brief studies, for the most part reported during the past year in the *Comptes rendus de la Société de Biologie*. Beginning with pathological subjects, he shows that the reaction-time of hysterical hemianæsthesics is generally longer than normal (and, as some of his experiments seem to show, the rate of nervous transmission on the diseased side slower) when the diseased side has part in the pro-

cess, the lengthening corresponding in general to the diminution of sensibility and muscular power. These changes in force and rapidity depend upon differences in nutrition which are in part demonstrable. The plethysmograph shows an increase of the volume of blood in the hand preceding the voluntary reaction, apparently one of its prerequisites. Other experiments show that the electrical resistance is less, and that the reduction of oxyhemoglobin is slower upon the anæsthetic side. The reaction-times and the reduction of oxyhemoglobin are strongly influenced by sense stimulation and by emotion, either natural or hypnotically suggested. Experiments were also made upon epileptics with reference to the quickness of the response before and after the paroxysm, the last being slower and corresponding to the anæsthesias and weakness which seem, in some degree at least, always present. The slowing does not seem to depend on the frequency of the attacks; it serves, however, to show the persistence of the stupor. Here also slow reactions accompany diminution of oxyhemoglobin, a fact that the author uses in defending the fatigue theory of post-epileptic paralyses.

Experiments on normal subjects show the same general relations between muscular vigor and quickness of response. With a new dynamometer of varied applicability, Féré has been able to compare the powers of extension and flexion of the different fingers among themselves and with their reaction-times. The following table shows the results in a single case:—

	FLEXION.		EXTENSION.	
	Dynamometer (Kilograms.)	Reaction-times (Seconds.)	Dynamometer (Kilograms.)	Reaction-times (Seconds.)
Thumb	4.200	0.163	1.200	0.19
Index finger	4.000	0.191	1.000	0.261
Middle "	3.500	0.193	.900	0.28
Ring "	2.000	0.201	.600	0.299
Little "	1.900	0.203	.400	0.31

A similar table from a pianist shows quicker reactions and greater strength in the last three fingers. In right-handed subjects the reaction-time is a little quicker on the right than the left, even when the reaction is made to the same stimulus by both, (in which case both are a little slower): *e. g.* (flexion) right hand alone, 0.12 sec.; left hand alone, 0.16 sec.; both hands together, right 0.14, left 0.18. Some subjects reversed the last relation, and developed more force and reacted more quickly with both hands; they were, however, rather defective epileptics. Normally it would seem that the "rapidity and abundance of the nervous avalanche are by so much the greater as the ways of discharge are less numerous." In the lower extremities which act most powerfully in extension, the extensors give the shortest reaction-times. Normal subjects give quicker and more forcible propulsions of the tongue than deaf-mutes and stutterers. The effect of warming the hand in hot water is to quicken reaction, the greatest change appearing in the fingers reacting most slowly before. Féré's experiments make an impression of care and judgment as compared with those of Rémond, reviewed in a previous number (*AM. JOUR. PSY.*, II, 486). They were, however, executed in part with the same questionable instrument, but in part also graphically with Marey's pneumatic drums. The number of observations going to a series were apparently small, and mean variations are never given—a serious omission if any intelligent judgment is to be passed upon the results.